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# SURVEY: NATIONAL ENVIRONMENTAL SATELLITE SERVICE

(NASA-CR-150546) SURVEY: NATIONAL  
ENVIRONMENTAL SATELLITE SERVICE (Teledyne  
Brown Engineering) 35 p HC A03/MF A01

N78-18098

CSCL 22A

Unclas  
G3/15 05927

November 1977



 **TELEDYNE  
BROWN ENGINEERING**

Cummings Research Park • Huntsville, Alabama 35807

TECHNICAL REPORT  
SD77-MSFC-2152

SURVEY: NATIONAL ENVIRONMENTAL  
SATELLITE SERVICE

Prepared For

DATA SYSTEMS LABORATORY  
MARSHALL SPACE FLIGHT CENTER  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
HUNTSVILLE, ALABAMA

Contract No. NAS8-32539

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# INTRODUCTION

The Department of Commerce, through the National Environmental Satellite Service (NESS) of the National Oceanic and Atmospheric Administration (NOAA), is responsible for the National Environmental Satellite System. Figure 1 shows the hierarchical relationship of the key organizational elements associated with this activity. Operational control and management of the program is delegated to NESS, which is located in Suitland, Maryland, with ground command and data acquisition stations at Wallops Island, Virginia, and Gilmore Creek, Alaska. NESS's responsibilities in this area include decisions on requirements/replacement, the actual operation of the satellites via their own ground stations, and the handling and processing of all data. NESS uses space technology (sensors and space systems) developed by NASA. NASA develops and/or procures the spacecraft and the launch vehicles according to Department of Commerce (DOC) specifications and is reimbursed with DOC funds.

The meteorological objectives of the operational NESS systems are:

- To extend knowledge and understanding of the atmosphere and its processes by viewing the evolution and nature of storms and other atmospheric phenomena
- To contribute to the development of a domestic and international in-situ environmental data collection network
- To improve NOAA's capability for forecasting and providing real-time warnings of solar disturbances
- To provide for growth in the kind, quantity, and quality of environmental parameters measured
- To advance the application of meteorological satellite data toward the improvement of weather forecasting services.

NESS operational system elements include flight programs directed toward the aforementioned objectives, Command and Data Acquisition (CDA) stations, a Satellite Operation Control Center (SOCC) through which

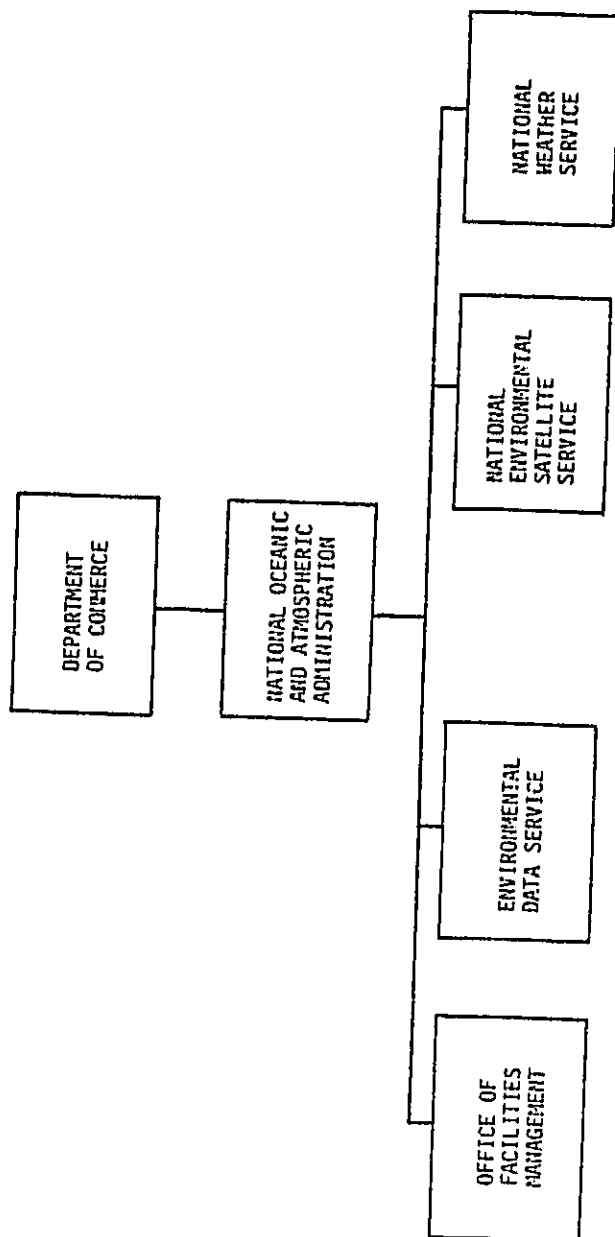


FIGURE 1. NOAA ORGANIZATIONAL STRUCTURE

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satellites are controlled and data are acquired, facilities for the processing and analysis of satellite products, and laboratories for satellite sensor experiments and applications development.

NESS receives data at periodic intervals from satellites of the Synchronous Meteorological Satellite/Geostationary Operational Environmental Satellite (SMS/GOES) series and from the Improved TIROS (Television Infrared Observational Satellite) Operational Satellite (ITOS). The two SMS/GOES satellites currently in operation are located at 75°W and 135°W longitude in geosynchronous orbits 35,800 km over the equator. They are equipped with a Visible and Infrared Spin Scan Radiometer (VISSR), a Space Environment Monitor (SEM), and data-relaying capabilities. The ITOS satellite series are in near sun-synchronous (quasi-solar) polar orbits (1,450 km altitude). Sensor onboard ITOS include the Scanning Radiometer (SR), Very High Resolution Radiometer (VHRR), Vertical Temperature Profile Radiometer (VTPR), and the Solar Proton Monitor (SPM). Data are relayed to the ground via VHF and S-band frequencies.

Within the conterminous United States, direct readout and processed products are distributed to users over facsimile networks from a central processing and data distribution facility. In addition, the NESS Satellite Field Service Stations (SFSSs) analyze, interpret, and distribute processed geostationary satellite products to regional weather service activities. These SFSSs are located in Miami, Kansas City, San Francisco, Honolulu, and Washington, D.C.

# 1. DATA GENERATOR ELEMENTS

The SMS/GOES satellite carries two sensors: 1) the VISSR and 2) the SEM. For a comprehensive description of these two sensors, refer to the September 30, 1977, issue of "Remote Sensing Data Handbook", produced by New Technology, Inc.

The VISSR sensor scans the full disk of the Earth in 18.2 min, with the capability of viewing in the visible and infrared spectra. During the forward scan of the sensor, data are generated at a rate of approximately 28 Mbits/sec. The forward scan consumes approximately 5% (30 msec) of each scan cycle and the back scan consumes the remaining 95% of the time. A complete scan of the full disk of the Earth involves 1,821 latitude (west to east) scan cycles.

The data resolution of the VISSR is changeable on command, with an associated reduction in the area of coverage. Available resolutions are:

Visible Data	0.9 km
	1.9 km
	3.7 km
IR Data	8 × 4 km
	8 × 8 km.

Reductions in coverage associated with the different resolutions range from approximately 1,000 mi<sup>2</sup> at 0.9 km to full disk diameter at 7.4 km resolution.

The SEM sensors continuously monitor solar activity. These data are used for environmental research and for alerting ground communication systems of ongoing solar storm activity of importance.

The ITOS satellite carries four sensors as follows:

- Scanning Radiometer (SR)
- Very High Resolution Radiometer (VHRR)
- Vertical Temperature Profile Radiometer (VTPR)
- Solar Proton Monitor (SPM).

Detailed descriptions of these four sensors are provided in the "Remote Sensing Data Handbook" referred to in the introduction to this section. The following paragraphs present a brief description of each sensor.



The SR sensor is a two-channel imaging device that continuously scans in a horizon-to-horizon crosstrack mode with scan steps provided by the forward motion of the spacecraft. Visible data resolution is approximately 4 km and infrared data resolution is approximately 8 km at the satellite subpoint.

The VHRR sensor detects energy in the visible spectrum and infrared window region with a scanning system similar to the SR sensor. Visible and infrared resolutions are approximately 0.8 km at the satellite subpoint.

The VTPR sensor obtains data from which the vertical temperature structure of the atmosphere can be inferred by viewing in eight separate spectral channels. When these data are combined, temperature profiles and total water vapor content of the atmosphere can be obtained from the surface to 30 km.

The SPM sensor measures the flux of energetic particles (protons, electrons, and alpha particles) toward the Earth. These data, like those obtained from the SEM, are used in forecasting and warning of solar storm activities and in environmental research.

The polar-orbiting satellites provide raw data readout of SR, VHRR, VTPR, and SPM data to ground receiving stations throughout the world having Automatic Picture Transmission (APT) and modified S-Band High Resolution Picture Transmission (HRPT) receiving equipment.

## 2. SPACE DATA PROCESSING ELEMENTS

To be determined.

### 3. SPACE DATA STORAGE ELEMENTS

To be determined.

## 4. SPACE DATA HANDLING

Space data handling for SMS/GOES and ITOS are partially covered herein. Only those data available as of October 1, 1977, are included.

### 4.1 SMS/GOES DATA HANDLING

VISSR data on SMS/GOES are acquired and transmitted during the forward scan of the VISSR. The forward sweep lasts for 30 msec and generates one block of data that are made up of eight bands in the visible spectrum and two bands in the infrared spectrum. The data block transmitted to the Earth multiplexes the visible and IR data into a 56-bit/word format, consisting of eight 6-bit visible words and either an alternating 8-bit IR Word or an 8-bit synchronization word. The data are transmitted in real time using a 28 Mbit/sec burst.

### 4.2 ITOS DATA HANDLING

ITOS data consist of the vertical temperature sensor, which produces 512-bit/sec digital data that are recorded and played back to the ground at a ratio of 22.5:1, and ten bands of analog data that are frequency-multiplexed onto the downlink. The digital and analog data are returned to the ground via two separate links.

The bandwidth of the analog data transmitted to the ground is a function of which sensors and how many sensors are being brought back at one time. The bandwidth ranges from 12 kHz to 400 kHz at baseband. Future satellites (e.g., TIROS-N) will transmit only digital data.

## 5. SPACE-TO-GROUND COMMUNICATION ELEMENTS

### 5.1 SMS/GOES COMMUNICATION ELEMENTS

The SMS/GOES communications link to the ground includes a 28-Mbit/sec downlink for handling image data, a 2-Mbit/sec relay link for relaying 2-Mbit/sec image data between the Wallops Island Command and Data Handling Station and Suitland, Maryland, and a 48-kHz relay link (WEFAX) for transmitting processed images to users with appropriate receiving stations. This last capability is on a time-sharing basis with VISSR and is available for eight 10-min slots per day. The SMS/GOES space-to-ground communication configuration is illustrated in Figure 5-1.

#### 5.1.1 SMS/GOES Space Communication Elements

A complete description of the onboard communication system was not available at the time this report was prepared. All links operate in the S-Band region using a high-gain dish antenna that is mechanically despun from the spacecraft, which rotates at a rate of 100 rpm. Thus the antenna gain at the ground receiving station remains constant.

#### 5.1.2 SMS/GOES Ground Communication Elements

Ground communication elements discussed in this section pertain only to those links to/from space. Ground distribution links are covered in Section 9.

The ground interface to SMS/GOES communications is two 60-ft dish antennas located at the Wallops Island Command and Data Acquisition facility. One antenna handles data to/from the satellite located at 135°W longitude. The other antenna handles data to/from the satellite located at 75°W longitude. Both antennas operate at S-band and use cryogenically cooled front-end parametric amplifiers with noise figures of 15 K and gains of 30 dB. NOAA has determined that adequate signal-to-noise ratios can be maintained with air-cooled front-end amplifiers with 40 K noise temperatures. Therefore, a decision has been made to use these higher noise temperature devices and eliminate the need for cryogenic cooling. The antennas each have a 1-deg beamwidth and a gain of 44 dB.



The 2-Mbit/sec VISSR data and the WEFAX data from the CDA station at Wallops Island are both transmitted to the SMS/GOES via these 60-ft dishes. The data are relayed to the ground via the SMS/GOES onboard communication system. The ground receiving antenna for the 2-Mbit/sec link is a 20-ft dish. The size of the WEFAX dish was not established.

The S-Band signals are down-converted to 70 MHz at the antenna prior to transmission to the blockhouse. The receivers in the blockhouse are Microdyne 1100 AR units. Nine of these receivers are available. The 1100 AR receiver is highly modular and can be configured to handle a wide range of frequencies, bandwidths, and modulations. Thus these same receivers will be applicable to future NOAA programs currently under consideration.

## 5.2 ITOS COMMUNICATIONS ELEMENTS

ITOS data are received via two S-Band communication links. One link transmits the digital recorder data from the Vertical Temperature Sensor and the second link transmits the analog data from the remaining ITOS sensors.

ITOS data are received at both the Gilmore Creek and Wallops Island sites. These data are received via an 85-ft dish antenna with a system noise temperature of 40 K. The antenna has the capability to receive frequencies in the VHF through S-Band range. The signals are down-converted at the antenna to 400 MHz and forwarded to six multifunction receivers, developed by NASA and built by RF Communications, Inc. Even more so than the Microdyne 1100 AR receivers used on GOES, the multi-function receivers are modular and configurable to support a wide range of frequencies, bandwidths, and modulations. Thus TIROS-N and other advanced NOAA missions could use this same receiving system.

The ITOS space-to-ground communication configuration, including the link back to Suitland, Maryland, is illustrated in Figure 5-2.

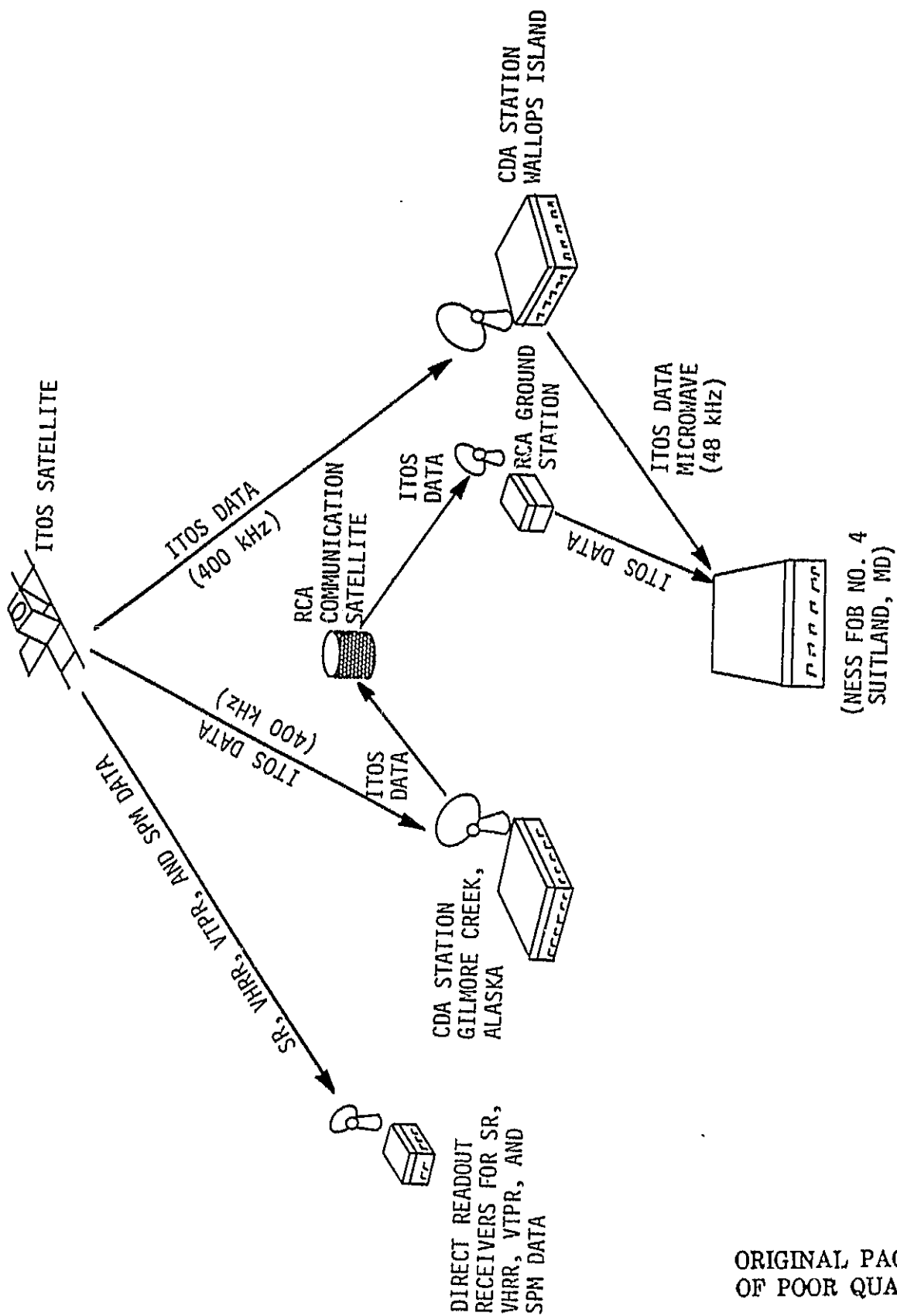


FIGURE 5-2. ITOS SPACE-TO-GROUND COMMUNICATIONS

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## 6. PRE-PROCESSING ELEMENTS

### 6.1 SMS/GOES PRE-PROCESSING ELEMENTS

Twenty-eight-megabit-per-second data from SMS/GOES are routed from the Microdyne 1100 AR receivers to a special decommutator and buffer, designated as the Synchronizer Data Buffer. The Synchronizer Data Buffer stores one complete scan line and outputs it to the GTE Tempo II minicomputers, which apply geometric and radiometric corrections and overlay a grid structure onto the data. The corrected data are then retransmitted at a 2-Mbit/sec rate back to the SMS/GOES satellite, which relays it to Suitland.

The pre-processing function is essentially a real-time process that takes place during the backscan of the satellite sensor. All corrections and retransmission of scan line  $n$  are completed prior to reception of scan line  $n+1$  at the ground station. Pre-processing of scan line 1821 (the last scan line) - and thus the entire picture - is completed and transmitted to Suitland within 600 msec of the time that the last line is received.

### 6.2 ITOS PRE-PROCESSING ELEMENTS

Pre-processing information on ITOS was incomplete at the time of report preparation. The data are pre-processed at Wallops Island prior to retransmission to Suitland. The pre-processing and retransmission require approximately 1 hr and 45 min, which is slightly less than one orbital period. Retransmission to Suitland takes place over a 48-kHz land line. The data are slowed down by a ratio of 8:1 to permit transmission.

## 7. PROCESSING ELEMENTS

The processing elements presented in this section are those that exist at the NOAA Central Computer Facility located in Suitland, Maryland. This processing facility is shared by a number of NOAA organizations, including the National Meteorological Center (NMC), which is discussed in a separate survey report.

### 7.1 NESS PROCESSING ELEMENTS

Three IBM 360/195 computers, connected by computer-to-computer (CTC) interface, are the primary components of the NOAA Central Computer Facility. This system is used by NESS to process data transmitted from the SMS/GOES and ITOS satellites, to produce photographic imagery, and to generate facsimile products for distribution to NESS users. The system is also shared by the NMC and the Office of Hydrology, as well as by other NOAA elements. Figure 7-1 depicts the general hardware configuration of the Central Computer Facility and Figure 7-2 shows the normal software configuration of the 360/195 complex.

#### 7.1.1 NESS Data Input

NESS data inputs are derived from SMS/GOES and ITOS satellites. The processing load from these two satellites comes to approximately  $10^{13}$  bits/day. Section 1 presented a brief description of each of the input sensors. A more complete description, including data rates, may be found in the "Remote Sensing Data Handbook".

#### 7.1.2 NESS Data Products

NESS produces a wide range of products to national and international users. These products are used by the NMC and international forecasters for producing national and international forecasts, by DOD forecasters for producing forecasts over areas with limited or no coverage from terrestrial-based sources, by WSFOs and/or area forecasters for verifying local weather patterns, by private and other users for producing independent forecasts, and by the news media for public weather data.

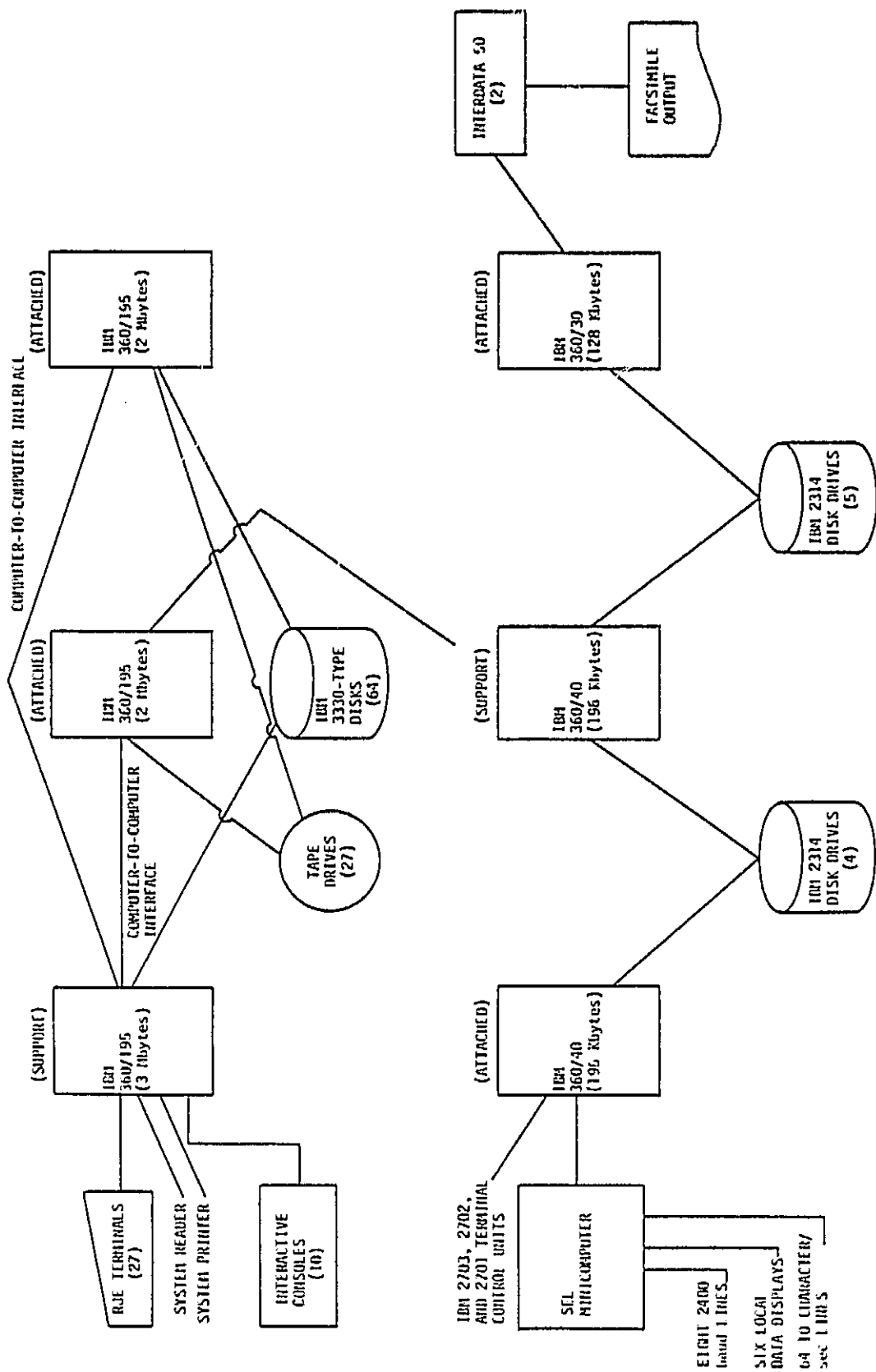


FIGURE 7-1. GENERAL HARDWARE CONFIGURATION OF NOAA DATA PROCESSING FACILITY

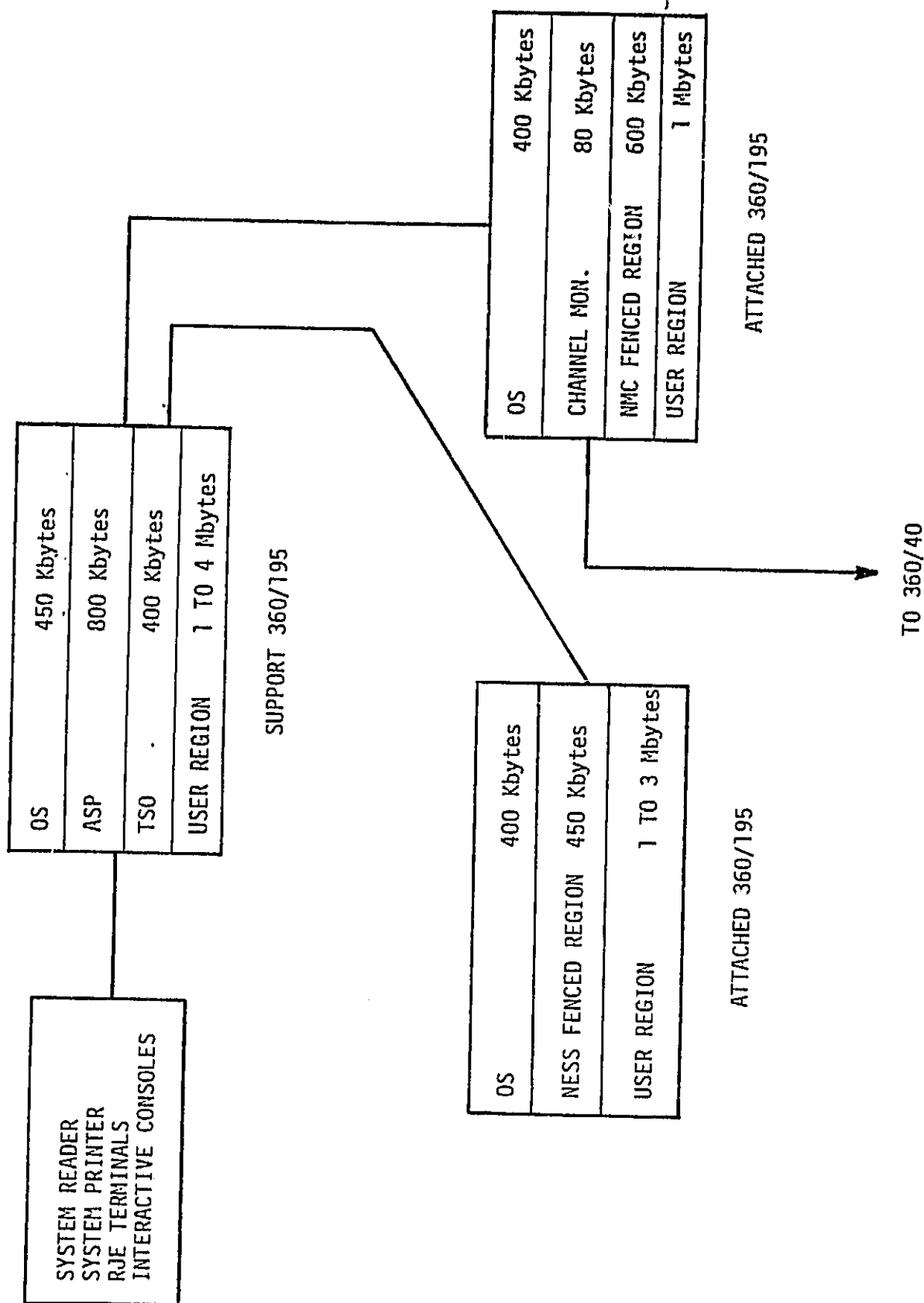


FIGURE 7-2. NORMAL SOFTWARE CONFIGURATION OF THE NOAA  
IBM 360/195 COMPLEX

NESS products include photographic data, TV movie loops, Cloud Cover Depictions, gridded and ungridded facsimile displays, WEFAX pictures, Mercator/polar projections, cloud motion movie loops, atmospheric profiles of temperature and humidity, Satellite Interpretation Messages, Satellite Weather Bulletins, Tropical Disturbance Summaries, Two-Layer Moisture Analysis Charts, and Global Sea Surface Temperature observations. The following paragraphs discuss each output briefly.

The Field Services Division of NESS distributes photographic data to NWS offices and other users at periodic intervals. The VISSR data from the two SMS/GOES satellites are used to produce two complete full-disk data sets each hour. One data set covers the visible spectrum; the other covers the IR spectrum. NESS provides users with full disks and with sectors of 1, 2, 4, and 8 km resolution according to their needs. Photographs are available either gridded or ungridded.

Movie loops for television use are produced using either the visible or IR images produced by the VISSR. These data sets are computer-generated using a sequence of negatives separated by half-hour intervals, and may consist of any selected combination of spatial resolutions or densities.

The U.S. Cloud Cover Depiction is sent out to the news media wire services via landline and to in-house users by mail once daily. The product used in-house consists of a photographic display and brief narrative description of the location of cloud cover and weather over the continental United States. The wire services receive a photographic display and a narrative combined for facsimile transmission.

The VISSR data are also used in the computer-derived production of gridded and unrectified facsimile displays. These displays present the data in an unaltered form (unrectified) with an overlay of latitude and longitude lines and the outlines of land masses and U.S. state boundaries. The resolution of visible data is 4 by 4 km, and IR data resolution is 4 by 8 km. A few displays are also transmitted in the form of polar-stereographic and Mercator projections using a 1:30M and 1:120M scale, respectively.

A service known as Weather Facsimile (WEFAX) is available to the Automatic Picture Transmission (APT) receiving community having S-Band receivers. Both mapped SR data from the ITOS satellites and unmapped VISSR data from the SMS/GOES series satellites are processed in the NESS computer system and broadcast via the SMS/GOES satellites. The polar-stereographic mapped SR images have a resolution of approximately 8 km and, depending on the schedule, may contain either visible or infrared imagery.

ITOS data are routinely mapped into Mercator or polar projections. Two polar projections and one Mercator projection are produced each day and are distributed throughout the world via facsimile circuits.

Cloud-motion vector fields, which are based on analysis of movie loops from geostationary satellites, are another NESS product. These outputs are produced daily at 00 and 12 GMT and are delivered to users by 03 and 15 GMT, respectively. The derived data are ingested into NMC's numerical forecast models, sent to users via teletype, and archived on computer tapes.

VTPR data from the ITOS satellites are currently being used to produce operational atmospheric profiles of temperature and humidity on a global scale. The ITOS satellites produce global coverage twice daily with profiles valid at 00 GMT and 1200 GMT for open-water ocean areas.

The Satellite Field Service Stations issue Satellite Interpretation Messages, which are general synopses of the weather affecting the United States. These products are sent out via teletype two to eight times per day, depending on the issuing office. Figure 7-3 shows an example of this product.

Satellite Weather Bulletins are coded messages describing past (12 and 24 hr previous) and present location, movement, intensity, and general cloud characteristics of tropical cyclones. Meteorologists routinely analyze and interpret polar-orbiting and geostationary satellite data images over all ocean areas for potential and existing tropical disturbances and prepare bulletins, such as that shown in Figure 7-4, which are to be sent out as necessary via teletype.

U.S. VIEW FROM 7PM EDT JULY 3 TO 7AM EDT JULY 4

OVER THE EASTERN UNITED STATES THUNDERSTORMS ARE PRESENT ALONG A COLD FRONT MOVING SLOWLY SOUTHEASTWARD THROUGH THE MIDDLE ATLANTIC STATES AND NORTHERN OHIO VALLEY. ONE AREA OF THUNDERSTORMS MOVES OFF THE DELMARVA PENINSULA AFTER CAUSING ONE TORNADO NEAR BALTIMORE YESTERDAY. NEW THUNDERSTORMS FORM DURING THE NIGHT FROM ILLINOIS TO OHIO AND DRENCH DAYTON, OHIO WITH AN ADDITIONAL INCH OF RAIN FOLLOWING A NEARLY FOUR INCH RAINFALL TOTAL YESTERDAY.

ALONG THE WESTERN GULF COAST THUNDERSTORMS ARE SEEN WEAKENING DURING THE NIGHT WHERE THE HIGH THIN CLOUDS FROM THE THUNDERSTORM TOPS BLOW OFF IN A LARGE COUNTERCLOCKWISE PATTERN: EVIDENCE OF THE WEAK UPPER LOW OVER THAT AREA.

THE ROCKY MOUNTAIN STATES RECEIVE SIGNIFICANT RAINFALL AMOUNTS FROM THE THUNDERSTORMS THAT REACH A MAXIMUM INTENSITY SHORTLY AFTER THE BEGINNING OF THE MOVIE THEN WEAKEN SLOWLY DURING THE NIGHT. BILLINGS, MONTANA AND SURROUNDING AREAS RECEIVED UP TO THREE INCHES OF RAIN OVERNIGHT NECESSITATING FLASH FLOOD WARNINGS IN SOME SECTIONS OF SOUTHEAST MONTANA.

THE WEST COAST STATES ARE MOSTLY CLEAR EXCEPT FOR HIGH THIN CLOUDS RAPIDLY CIRCLING AN UPPER LOW JUST OFF THE NORTHERN CALIFORNIA COAST AND SOME LOW CONTRAST BETWEEN THE TOPS OF THE WARM CLOUDS AND THE GROUND SURFACE.

EASTERN U.S. VIEW FROM 9:30AM EDT TO NOON JULY 4

ONE AREA OF THUNDERSTORMS HAS CONTINUED SOUTHEASTWARD INTO THE MIDDLE ATLANTIC STATES WITH A NEW LINE OF THUNDERSTORMS FORMING OVER THE LOWER OHIO VALLEY. SHOWER CLOUDS HAVE FORMED IN THE MIDDLE ST. LAWRENCE VALLEY AND ARE MOVING INTO EXTREME NORTHERN NEW ENGLAND.

WESTERN U.S. VIEW FROM 9:30AM EDT TO NOON EDT JULY 4

A FEW NEW THUNDERSTORMS ARE FORMING OVER THE TEXAS PANHANDLE, ARIZONA AND MONTANA. HIGH THIN CLOUDS CONTINUE TO MOVE RAPIDLY COUNTERCLOCKWISE AROUND THE LARGE UPPER LOW OFF THE CALIFORNIA COAST.

FIGURE 7-3. EXAMPLE OF SATELLITE INTERPRETATION MESSAGE

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SATELLITE WEATHER BULLETIN

NOAA-4 VIS/IRDAY WEST PACIFIC

RUBY

01 JULY 1976

0022Z

23N 126.1E

T5.5/5.5/DO.5/24HRS

PAST POSITIONS: E21.2N 124E 301209Z IRNITE  
21.1N 122.9E 300123Z VIS/IRDAY

CENTER DEFINED BY ROUND DISTINCT EYE APPROX ONE-THIRD DEG DIA.

PLEASE ACK  
SGD/NOAA-NESS

ABXX 13 KWBC

SATELLITE TROPICAL DISTURBANCE SUMMARY

ALL MOVEMENTS AND TRENDS 24 HRS UNLESS OTHERWISE STATED

WEST PACIFIC NOAA 4 VIS/IRDAY 302000-010200Z

23N 126.1E 0022Z T5.5/5.5/DO.5/24HRS RUBY

27.2N 142.3E 2226Z T4.5/4.5MINUS/SO.0/24HRS SALLY

BRKN BAND MOD ACTIVE CONV DEVELOPED FROM YDA EXTENDS 9N 144E to  
EQ. 140E to eq. 135E DEG WIDE. WIDELY SCTD BAND MOD ACTIVE CONV  
WEAKER THAN YDA EXTENDS 4N 180W to 5N 170E to 13N 160E 1 DEG WIDE.

SOUTH PACIFIC NOAA 4 VIS/IRDAY 301500-32300Z

SCTD BAND MOD ACTIVE CONV SAME AS YDA EXTENDS 10S 150E to 12S 160E  
2 DEG WIDE. SCTD AREA MOD ACTIVE CONV SAME AS YDA 5-7S FROM 147E to  
156E. BRKN AREA MOD ACTIVE CONV DEVELOPED FROM YDA CENTERED 20S 170E  
2 DEG DIA.

7/1 0530 A

FIGURE 7-4. EXAMPLE OF SATELLITE WEATHER BULLETIN



A Tropical Disturbance Summary is a coded message listing of all Satellite Weather Bulletins sent during the previous 24 hr and the locations of all vertices with a tropical history, significant disturbed areas, and the Intertropical Convergence Zone (ITCZ). An example of this output is shown in Figure 7-5. Two summaries are sent via teletyp per day for each ocean area covered. These areas are the Atlantic and Eastern Pacific (to 180°W), West and South Pacific, and the Indian Ocean. The summaries are prepared by meteorologists using visible and infrared satellite imagery from both the polar-orbiting and geostationary satellites.

The Two-Layer Moisture Analysis Chart, as shown in Figure 7-6, is prepared by NESS analysts showing the Mean Relative Humidity (MRH) over the eastern North Pacific, the western North Atlantic, and the Gulf of Mexico. An eight-scale MRH contour is determined for the 1,000- to 700-mb and the 700- to 500-mb layers of the atmosphere by manually viewing geostationary and polar-orbiting satellite imagery and VTPR data. These data are plotted on a 30- by 40-cm, 1:20M base map and compared with the 12-hr Primitive Equation (PE) moisture prognosis for adjustment of the computer-derived relative humidities. The correctional data are punched on cards and read into the computer for an update to the 00 and 12 GMT NMC moisture analysis and the Quantitative Precipitation Forecasts (QPF) of precipitable water and precipitation.

Global Sea Surface Temperature (SST) observations are obtained daily from the Scanning Infrared Radiometer (SIR) on ITOS. A fully automated computer model called GOSSTCOMP (Global Operational Sea Surface Temperature Computation) is used to generate 8,000 to 10,000 time- and Earth-located values of SSTs. The derived observations are stored on disk for NOAA 360/195 terminal users and are also used to produce photographic displays and gridded fields. The photographic displays enable the user to view the global SST pattern and the spatial distribution of observations used in the analysis. The gridded fields, such as those shown in Figure 7-7, are available as Mercator projections

ADXX 16 KWBC

SATELLITE TROPICAL DISTURBANCE SUMMARY

ALL MOVEMENTS AND TRENDS 24 HRS UNLESS OTHERWISE STATED

CENTRAL AND WEST PACIFIC NOAA-4 IRNITE 270543Z TO 271330Z

BRKN MODERATELY ACTIVE TO ACTIVE ITCZ HAS INCREASED IN INTENSITY...  
ITCZ 3 TO 4 DEG WIDE BEGINNING IN EAST PACIFIC FROM 9N 140W TO 5N  
155W TO 6N 177W TO 4N 168E.

MODERATELY ACTIVE CONVECTIVE AREA THAT HAS WEAKENED AND MOVED 4 DEG  
TO THE WEST...5 DEG DIAMETER CENTERED 13N 131E.

BRKN MODERATELY ACTIVE CONVECTIVE AREA THAT HAS INCREASED IN ACTI-  
VITY PAST 12 HRS...5N TO 19N BETWEEN 120E AND 126E.

BRKN ACTIVE CONVECTIVE AREA BOUND BY 20N 160E TO 18N 172E TO 33N  
175E TO 20N 160E...HAS EXHIBITED LITTLE MOVMENT AND CHANGE.

VORTEX DESCRIBED BY UPPER CLOUDS AT 34N 164E.

NO TROPICAL CYCLONE ACTIVITY NOTED.

SOUTH PACIFIC NOAA-4 IRNITE 270340Z TO 271127Z

BRKN MODERATELY ACTIVE CONVECTIVE AREA THAT HAS SHOWN LITTLE CHANGE...  
BOUND BY 2N 158E TO 10S 160E TO 1N 135E TO 2N 158E.

NO TROPICAL CYCLONE ACTIVITY NOTED.

FIGURE 7-5. EXAMPLE OF SATELLITE TROPICAL DISTURBANCE  
SUMMARY

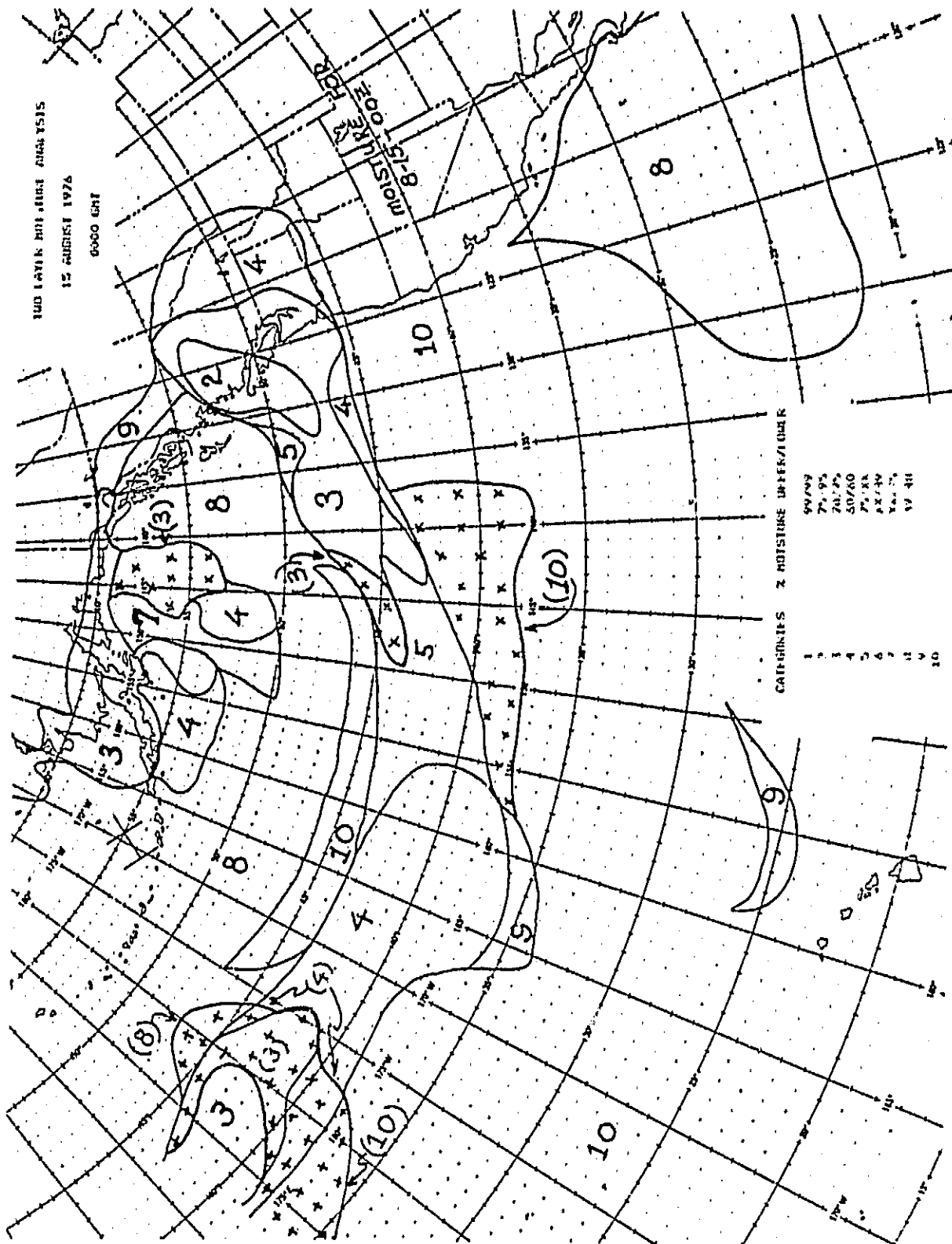


FIGURE 7-6. EXAMPLE OF A TWO-LAYER MOISTURE ANALYSIS

# GOSSTCOMP SEA SURFACE TEMPERATURE

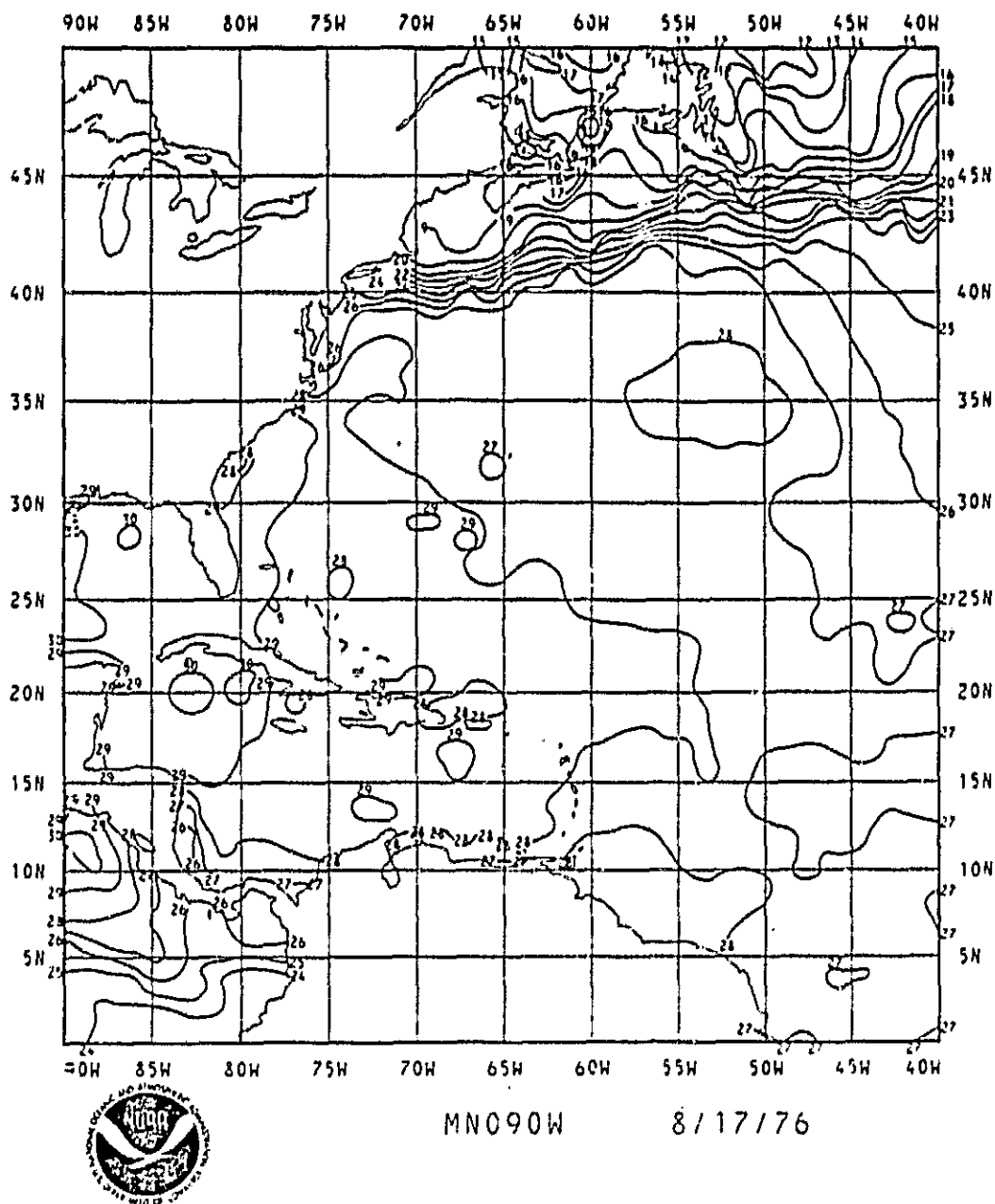


FIGURE 7-7. EXAMPLE OF GOSSTCOMP GRIDDED ANALYSIS OF SEA SURFACE TEMPERATURES

from 50°N to 50°S latitude and in polar-stereographic projections for the remainder of the globe. The gridded fields are mailed to users once a week.

During a normal day at NESS, several briefings and advisory communications take place between its members and the personnel of NMC and various concerns that depend on satellite data. At various times during the day, the Synoptic Analysis Section is in contact with the Satellite Field Service Stations. This is accomplished via telecopiers that enable NESS personnel to keep the field service stations informed of any new developments with current weather, program changes, etc., and vice versa. The meteorologists in NMC are briefed on current satellite data to supplement the numerical forecasts and the conventionally observed data that are available. The NESS briefer uses analyzed charts, movie loops, and satellite photographic images to inform the NMC forecaster of current weather conditions as seen from the SMS/GOES and ITOS satellites.

#### 7.1.3 NOAA Central Computer Facility Hardware

The principal data-processing hardware elements within the NOAA Center Computer Facility are:

- Three IBM 360/195 computers (The support system has 3 Mbytes of memory and each of the attached systems has 2 Mbytes)
- Two IBM 360/40 computers (Each has 196 Kbytes of memory)
- One IBM 360/30 computer (with 128 Kbytes of memory)
- One SEL minicomputer
- Two Interdata 50 minicomputers
- Sixty-four IBM 3330-type disk drives (100 Mbytes each)
- Nine IBM 2314 disk drives
- Twenty-seven tape drives
- Twenty-seven RJE terminals.

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Figure 7-1 is a diagram of the above NOAA Central Computer Facility hardware. As pointed out previously, this facility is shared by NESS, NWS, and numerous other NOAA organizations.

#### 7.1.4 NOAA Central Computer Facility Software

The support 360/40 and the facsimile 360/30 computers operate under DOS. The attached 360/40, which handles communications, operates under CCAP (an IBM-originated, locally modified communication system). The support 360/40 has one foreground partition operating the channel-to-channel interface with the support 360/195. The control program associated with this function operates in the file interleaved mode. The support 360/40 also operates the National Weather Service KCRT system and provides a time-controlled region for batch processing of data.

The KCRT controller permits entry of inquiry and control instructions by remote users of the network. A disk-swapping technique is used to allow programs to carry out conversational sequences independent of the action occurring at another station. The three IBM 360/195s operate under OS. The support system also runs the Automatic Spooling Program (ASP) and TSO. Each of the 360/195s has a reserved "fence" region for privileged users. One system has a 600K fence for NMC users; the second has a 450K fence for NESS users. Each 360/195 has a common user region of 1 to 1.4 Mbytes.

## 8. DATA BASE SYSTEM ELEMENTS

Data from NESS including video information, vertical temperature soundings, and sea surface temperatures are incorporated into the NMC data base for utilization by numerical models for forecasting, as well as by researchers in related areas. Currently, these data are placed on tape after processing and then entered into the data base. In the future, this intermediate step may be omitted. The data base is maintained on the three 330-type disks residing in the 360/195 facility.

The data base management software is tailored to the specific needs of NMC and NESS and was developed in-house over a period of years.

## 9. DATA DISTRIBUTION ELEMENTS

NESS distributes its products to users via a variety of methods, including direct reception from NESS satellites, a relay link using both the SMS/GOES satellite relay link and commercial satellites, telephone lines, telegraph, and the mail. The distribution network includes both intra-NESS and external distribution circuits. An overview of this network is presented in Figure 9-1. The user in the referenced figure includes the NMC, other NWS organizations, DOD, international users and private users. Many other distribution networks exist within this user box (e.g., the NMC distribution network, which includes the FAA Weather Message Switching Center Network, AFOS (future), and the international distribution networks). As a matter of fact, NESS data get integrated into the NMC forecasts and are thus indistinguishable from other data. Thus the NMC is the largest single distributor of NESS data products.

Key features of this distribution network are the 2-Mbit/sec link for relaying VISSR data (discussed in Section 5) and the interfaces to key weather facilities such as the National Severe Storms Forecast Center, the National Hurricane Center, and the Pacific Hurricane/Typhoon Forecast Centers via the Satellite Field Service Stations co-located with these key weather forecasting centers. Another key feature is the ability of international users with appropriate receiving facilities to have free access to either ITOS or SMS/GOES data. Those who do not have the capability to receive data directly have access to processed data via international distribution centers. The international network via the National Meteorological Center is presented in a report entitled, "Survey: National Meteorological Center".

Other than integrated forecasts by NMC, the next most extensive distribution network for NESS data is probably the WEFAX link. Key weather facilities, including weather service forecast offices, receive WEFAX data periodically.



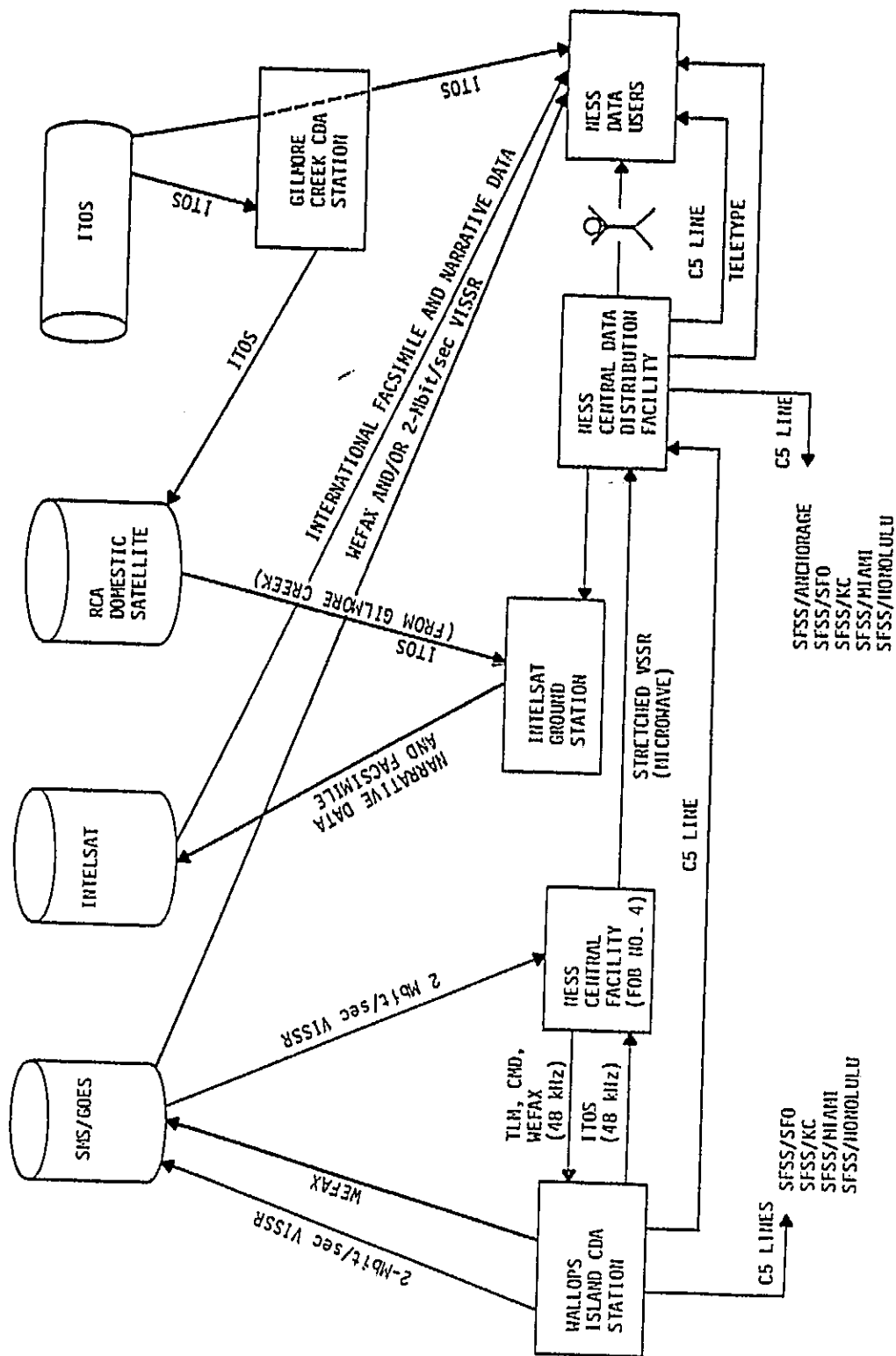


FIGURE 9-1. OVERVIEW OF NASS DATA DISTRIBUTION NETWORK

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## 10. INFORMATION PRESENTATION ELEMENTS

To be determined.

## 11. WORKLOAD/CAPABILITIES

The NESS satellites, the Command and Data Acquisition stations, and the NOAA processing and data distribution facilities are the primary components of NESS's capabilities. The capabilities of the satellite are a function of the data resolution, which is fixed for a given satellite; the capabilities of the Command and Data Acquisition stations are unique (but not restricted) to the satellites since they were designed specifically for satisfying the requirements of the individual satellites; and the workload of the NOAA data processing and data distribution network is ambiguous at best since the facility has so many users, some of whom are constantly changing their requirements. (As an example of this latter consideration, an associated report, entitled "Survey: National Meteorological Center", reports that NMC processing of upper-air data on the NOAA computer is expected to increase by a factor of 5 during late 1977, and there are questions in the minds of other users as to how this will impact the overall system.) Finally, the workload/capabilities of the Command and Data Acquisition stations have only limited pertinence to future planning because of program overlaps, modularity, technology, and other factors discussed in subsequent paragraphs.

A typical NESS satellite will have an operational lifetime of several (on the order of 5) years. Development of a replacement system requires several years, and the new system overlaps the operational system for several months before the existing system is phased out. As a result of the overlapping development and test phases, it is not possible for the two programs to share the same resources, either in space or on the ground. By the time a third-generation spacecraft development begins, the first-generation equipment, which was just retired, is on the order of 10 years old and is thus not compatible with the newer technology and requirements associated with the third-generation system. Both the SMS/GOES ground stations and the ITOS ground stations are

excellent examples of this. SMS/GOES pre-processors are already 7 to 8 years old and thus have a very limited capability. Newer minicomputers can increase the throughput and reliability of the next-generation satellites by an order of magnitude over these systems. The ITOS ground station is an analog facility, and newer-generation systems are being designed to be digital. Therefore, the TIROS-N ground station must be redesigned.

While the above discussion appears pessimistic, the picture is not entirely without hope. The antenna facilities at these sites, which are a major cost element, are normally shared. The newer receivers being used are highly modular and thus flexible so that they can be upgraded as requirements change and new technologies are introduced. Finally, the newer ground-processing and data-handling systems are highly modular; use highly reliable, long-life integrated circuits; and may be upgradable as requirements and technology change, assuming that the mission overlap problems can be overcome. Some hardware overlap is mandatory during the development cycle. Perhaps the major item that continues to be a high-cost item is software. The data-processing and the data-handling software for each mission is unique.

NMC personnel have stated that satellite data will become more useful in forecasting applications when the resolution of onboard sensors increase by a factor of 2 over present sensors. Future sensors should be capable of achieving this increased resolution.

The increased use of satellite data will result in a significantly higher processing load as a result of the high volume of data involved. The methodology for handling these increased loads has not been resolved. One approach under investigation calls for adding a fourth IBM 360/195 computer. Another approach calls for replacing the existing IBM computer with a super-scale computer in the CRAY-1 class. It is not known when this decision will be made.